Possible Macroeconomic Consequences of Large Future Federal Government Deficits

Ray C. Fair*

Revised February 2010

Abstract

This paper uses a multicountry macroeconometric model to analyze possible macroeconomic consequences of large future U.S. federal government deficits. The analysis has the advantage of accounting for the endogeneity of the deficit. In the baseline run, which assumes no large tax increases or spending cuts and no bad dollar and stock market shocks, the debt/GDP ratio rises substantially through 2020. The estimates from this run are in line with other estimates. Various experiments off the baseline run are then done. If the dollar depreciates, inflation increases but the effect on the debt/GDP ratio is modest. It does not appear that the United States can inflate its way out of its debt problem. If U.S. stock prices fall, this makes matters worse since output is lower because of a negative wealth effect. Personal tax increases or transfer payment decreases of three percent of nominal GDP stabilize the debt/GDP ratio, at a cost of a real output loss of about 1.6 percent over the next decade. The Fed's ability to offset these losses is modest according to the model. Introducing a national sales tax is more contractionary than is increasing personal income taxes or decreasing transfer payments.

---

*Cowles Foundation and International Center for Finance, Yale University, New Haven, CT 06520-8281. Phone: 203-432-3715; e-mail: ray.fair@yale.edu; website: *fairmodel.econ.yale.edu*. The results in this paper can be duplicated on the author's website, and alternative baseline runs and experiments can be done. I am indebted to William Brainard for helpful comments.

1 Introduction

It is widely expected that the federal government deficit will remain large for many years. The Congressional Budget Office (CBO) released estimates on August 25, 2009—CBO (2009b)—that showed a cumulative deficit between 2009 and 2019 of $8.7 trillion. The federal government debt as a percent of GDP was estimated to rise from 40.8 percent in 2008 to 67.8 percent in 2019. Auerbach and Gale (2009, Table 4) have for their "adjusted baseline" case the debt/GDP ratio rising from 54.0 percent in 2009 to 89.4 percent in 2019. The Obama administration's budget, released February 1, 2010, has the debt/GDP ratio rising from 53.0 percent in 2009 to 77.2 percent in 2020.

Many have argued that if something is not done to lower the deficit, bad things are likely to happen to the economy. Often cited are a depreciation of the dollar, a decrease in U.S. stock prices, and an increase in interest rates on U.S. government securities (because of added risk). There are, however, no quantitative estimates of these possible effects. One needs a model of the economy to obtain such estimates, and this has not been done. This paper presents estimates using a macro model. A baseline run is obtained where nothing bad happens, and then two alternative runs are made. The first assumes a large depreciation of the dollar, and the second assumes lower than average U.S. stock price increases. Since exchange rates and stock prices are essentially unpredictable, being determined in asset markets, this paper provides *conditional* estimates. Conditional on a particular response in asset markets to the deficit, estimated effects on the macro economy are provided.

Results are also presented of 1) increasing personal income tax rates, 2) lowering federal government spending on transfer payments, and 3) introducing a federal government sales tax. The economic effects of these changes are estimated, including the effects on the government deficit and debt.

The advantage of the procedure in this paper is that, given the model, consistent stories can be told. Asset-market changes and government policy changes affect both the macro economy and the government deficit, and the model takes into account these effects. In the solution of the model the predicted values of the deficit are consistent with the predicted values of the other endogenous variables.

The stress in this paper is on demand effects. The traditional concerns of the public finance literature on dead weight losses and inefficiencies from taxes are not considered. The implicit assumption here is that these effects are second order relative to macro demand and price effects regarding the current federal budget problem. There is a tax effect on labor force participation, as seen below, but the main focus is on the demand side.

2 The Model

A structural multicountry macroeconometric model, denoted the "MC model," is used in this paper. The MC model is presented in Fair (2004), and it has been updated for purposes of this paper (dated January 30, 2010). The updated version is on the author's website. The U.S. part of the MC model will be denoted the "US model," and the rest of the model will be denoted the "ROW model." Sometimes the US model is analyzed by itself, but in this paper the entire MC model is used. The methodology behind this modeling is compared to the methodology of dynamic stochastic general equilibrium (DSGE) modeling in Fair (2009a). The ability of the US model to forecast recessions and booms is analyzed in Fair (2009b). The MC model is completely estimated (by 2SLS); there is no calibration.

In the US model there are three estimated consumption equations, three investment equations, an import equation, four labor supply equations, two labor demand equations, a price equation, a nominal wage equation, two term structure of interest rate equations, and an estimated interest rate rule of the Federal Reserve, among others. In the interest rate rule the Fed responds to inflation and unemployment. There are a total of 28 estimated equations and about 100 identities in the US model. The unemployment rate is determined by an identity; it equals unemployment divided by the labor force. In the identities all flows of funds among the sectors (household, firm, financial, state and local government, federal government, and foreign) are accounted for. The federal government deficit is determined by an identity, as is the federal government debt. There is an estimated equation determining the interest payments of the federal government as a function of interest rates and the government debt.

The ROW model consists of estimated equations for 37 countries. There are up to 13 estimated equations per country and 16 identities. The estimated equations explain total imports, consumption, fixed investment, inventory investment, the domestic price level, the demand for money, a short term interest rate, a long term interest rate, the spot exchange rate, the forward exchange rate, the export price level, employment, and the labor force. The specifications are similar across countries. The short term interest rate for each country is explained by an estimated interest rate rule for that country. In some cases the U.S. interest rate is an explanatory variable in the estimated rule, where the Fed is estimated to have an effect on the decisions of other monetary authorities. The exchange rates are relative to the dollar or the euro. The two key explanatory variables in the exchange rate equations are a relative interest rate variable and a relative price level variable. The ROW model consists of 275 estimated equations.

There are 59 countries in the MC model (counting an "all other" category), and the trade share matrix is 59$\times$59. Data permitting, a trade share equation is estimated for each country pair. A total of 1,302 trade share equations are estimated. The trade share data are from the IFS Direction of Trade data. Quarterly data are available back to 1960.

There are many links among countries. The use of the trade shares means that the differential effects of one country's total demand for imports on other countries' exports are accounted for. There are interest rate links through the U.S. interest rate affecting some other countries' rates in the estimated interest rate rules. In a few cases the euro (earlier German) interest rate affects other countries' interest rates. Exports are endogenous for each country, depending on the imports of other countries, which are endogenous. The price of exports in local currency of each country is endogenous, depending on the domestic price level, which is endogenous. The price of exports in dollars is endogenous because the price of exports in local currency is endogenous and the exchange rate is endogenous. The price of imports in each country is endogenous because it depends on the price of exports of the other countries weighted by the trade shares. The price of imports affects the domestic price level in each country's estimated domestic price equation, which means that there are price links among countries. An increase in the price of exports in dollars in one country leads to increases in other countries' import prices, which affects their domestic and thus export prices, which feeds back to the original country, etc.

The main focus of this paper is on the United States, and the effects of the experiments on the other countries will not be discussed. All the results are on the author's website. Before discussing the experiments, it will be useful to review a few of the model's properties for the United States.

The U.S. output multiplier for a change in U.S. government purchases of goods and services is about 2.0 after four quarters. (For all the multipliers discussed here the estimated interest rate rule of the Fed is included in the model—monetary policy is endogenous.) The multiplier for a change in the personal income tax rate is about 1.0 after four quarters. The same is true for a change in government spending on transfer payments to households. If the interest rate rule is dropped and the short term interest rate is increased by 1 percentage point, real output falls by about 0.4 percent after four quarters and about 0.7 percent after eight quarters. Monetary policy has important effects on the economy, but not enough to come close to eliminating cycles. This is discussed in Fair (2005). Multipliers in the model from a sustained change in a policy variable generally peak between four and eight quarters and then decline after that.

There are important wealth effects in the model. An increase in household wealth, say from an increase in stock prices, leads to an increase in consumption. Spending out of wealth is about 4 percent per year of the wealth change. The household wealth variable in the model includes housing wealth. Tests that I have done show that the consumption response to a change in financial wealth is close to the response to a change in housing wealth, and the two are added together in the model.

The demand pressure variable in the price equation is the unemployment rate, and the cost shock variable is the price of imports. The nominal wage rate appears in the price equation, and the price level appears in the nominal wage equation. The price equation is discussed and tested against other specifications in Fair (2008). The price of imports is an important explanatory variable in the price equation, and this is why a depreciation of the dollar increases the domestic price level. The U.S. price of imports rises because of the depreciation, which affects the domestic price level.

DSGE models like the Galí and Gertler (2007) model have that property that a positive price shock is explosive unless the Fed raises the nominal interest rate more than the increase in the inflation rate. In other words, positive price shocks with the nominal interest rate held constant are expansionary (because the real interest rate falls). In the US model, however, they are contractionary. If there is a positive price shock like an increase in the price of imports, the real wage initially falls because nominal wages lag prices. This has a negative effect on consumption demand. In addition, household real wealth falls because nominal asset prices don't initially rise as much as the price level. This has a negative effect on consumption through a wealth effect. There is little if any offset from lower real interest rates because households appear to respond more to nominal rates than to real rates. Positive price shocks are thus contractionary even if the Fed keeps the nominal interest rate unchanged. An increase in the price of imports of 10 percent in the model with the nominal interest rate unchanged leads to a decrease in real

GDP of about .4 percent after four quarters. A tighter monetary policy would add to the contraction.

In the labor force participation equations the personal income tax rate has a negative effect on labor supply (substitution effect dominating) and wealth has a negative effect (positive income effect on leisure). This means, for example, that an increase in the personal income tax rate has a different effect on the unemployment rate than does an equivalent size decrease in transfer payments because of different effects on labor supply. Also, an increase in household wealth, other things being equal, has a negative effect on the unemployment rate (decrease in the unemployment rate) because of a decrease in labor supply. There is thus no stable relationship between aggregate output and the unemployment rate because of varying effects on labor supply—no stable Okun's law. Potential labor productivity is exogenous in the model. Actual labor productivity is endogenous: it is equal to output divided by worker hours, both of which are endogenous.

There are two long term interest rates in the model, a bond rate and a mortgage rate, and these are determined by estimated term structure equations. These equations have the property (supported by the data) that a sustained increase in the short term interest rate of a certain amount leads to the same change in the long term rates in the long run.

The federal government interest payments equation mentioned above is an important equation for purposes of this paper. It relates interest payments to interest rates and the federal government debt. The data on interest payments are national income and product accounts (NIPA) data, and the data on the debt are flow of funds accounts data. The link between interest payments and the debt is complicated because it depends on the time a security was issued, its maturity, and the interest rate at the time. The estimated interest payments equation is only a rough approximation. The interest rate used is a weighted average of the three-month rate and the current and seven lagged values of the bond rate. The interest payments equation is consistent with the historical data in the sense that it is estimated (no calibration), but it is still only a rough approximation. Regarding the term structure of interest rate equations, there is no adjustment for risk in the equations. Long terms rates depend on current and past short term rates. Any effects of the large federal deficits possibly increasing the interest rates that the federal government has to pay because of added risk are not captured in the model.

There is an equation in the US model explaining capital gains or losses on stocks held by the household sector (variable CG). The two right hand side variables in this equation are the change in the bond rate and the change in after tax profits. The equation explains very little of the variation in CG, and the two explanatory variables have very small effects on CG. This equation is modified for one of the experiments below.

3 The Baseline Run—Run 1

The results in this paper are based on actual data through 2009:4 (data available as of January 30, 2010). The prediction period is 2010:1–2020:4, 11 years. For the baseline run assumptions have to be made about future government policy. This is obviously difficult because tax and spending legislation changes over time. There are five key U.S. federal government spending variables in the model: purchases of goods, civilian jobs, military jobs, transfers to households, and transfers to S&L governments. There are five key exogenous U.S. federal government tax rates: personal income, corporate profits, indirect business, employee social security, and employer social security. The stimulus bill, passed at the beginning of 2009, affects some of these variables for 2009 through 2012. The baseline run uses CBO (2009a) estimates of the effects of the stimulus bill on government spending and taxes to guide the choice of the government tax and spending variables in the model through 2012. Then for 2013:1–2020:4 (after the stimulus measures end) the tax rates are taken to remain unchanged from their 2012:4 values.

The five federal government spending variables are taken to grow in real terms at constant rates. The following discussion gives an idea of how the chosen growth rates for the spending variables relate to actual past growth rates. Three periods are considered: Clinton (1993:1–2000:4), Bush (2001:1–2007:4), and since 1990 (1990:1–2007:4). The last two periods stop in 2007:4 because the stimulus bill and earlier legislation affected 2008 and 2009. The actual past growth rates and the projected growth rates are presented in Table 1. Whether these projections are likely to underestimate or overestimate spending is hard to say. Based on behavior since 1990, slightly higher values are used for purchases of goods and jobs and slightly lower values are used for transfer payments.

Given the choice for federal transfer payments to S&L governments, the values of the exogenous tax and spending variables for S&L governments were chosen so that the governments had roughly balanced budgets, something that most state constitutions require. The remaining exogenous variables in the model are either fairly easy to forecast, like population, or are small and not important. Values of

Table 1
Actual and Projected Federal Government Spending Variables
Percentage Changes at Annual Rates

Variable	Clinton 1993:1–2000:4	Bush 2001:1–2007:4	Since 1990 1990:1–2007:4	Projected 2013:1–2020:4
goods purchases	−1.1	7.5	2.5	3.0
transfers to households	2.3	4.5	3.9	3.0
transfers to S&L	4.5	3.2	5.1	3.0
civilian jobs	−1.5	0.0	−0.7	1.0
military jobs	−3.1	1.1	−1.9	0.0

each of these variables were chosen to be consistent with recent behavior. The main exogenous variable for each of the other countries is government spending. Remember that exports, export prices, and import prices are all endogenous in the MC model. No assumptions are needed for these.

Results for the baseline run are presented in Table 2. Values of eleven variables are presented for the fourth quarter of each year. A key point to remember throughout this paper is that there is much more uncertainty regarding the baseline run than there is regarding the difference between another run and the baseline run. Standard errors of differences are smaller than standard errors of levels because common errors in the two runs cancel out. Another way of looking at this is to note that the conclusions at the end of the paper are not likely to be sensitive to the use of different baseline runs.

The 10-year mean in Table 2 is the mean value of the variable for the 2011:4–2020:4 period. These means are, of course, forecast values. The 56-year mean is the mean value of the variable for the 1954:1–2009:4 period, which is the estimation period. The two mean values for the growth rate (**g**), the unemployment rate (**u**), and the inflation rate (π) are close, and so, under the above assumptions, the model

Table 2
Baseline Run and Two Bad Shocks

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
					Run 1. Baseline						
					Actual values						
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.364
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.391
2009.4	0.1	10.0	0.7	0.1	5.2	0.031	0.018	0.168	0.259	0.091	0.456
					Forecast values						
2010.4	3.9	8.4	1.7	1.1	4.7	0.034	0.023	0.172	0.243	0.072	0.549
2011.4	3.6	7.0	3.1	2.3	4.7	0.033	0.026	0.176	0.238	0.063	0.581
2012.4	3.7	6.1	3.8	3.2	5.0	0.033	0.028	0.179	0.238	0.059	0.598
2013.4	3.5	5.7	4.0	3.8	5.4	0.034	0.030	0.181	0.237	0.056	0.610
2014.4	3.4	5.4	4.0	4.2	5.8	0.035	0.032	0.183	0.238	0.055	0.621
2015.4	3.1	5.3	3.8	4.4	6.1	0.036	0.034	0.185	0.239	0.055	0.633
2016.4	2.9	5.4	3.5	4.4	6.3	0.035	0.037	0.186	0.242	0.055	0.647
2017.4	2.8	5.5	3.3	4.3	6.4	0.033	0.039	0.188	0.244	0.056	0.662
2018.4	2.9	5.5	3.2	4.2	6.4	0.030	0.041	0.189	0.246	0.056	0.678
2019.4	3.0	5.5	3.2	4.3	6.5	0.026	0.043	0.191	0.247	0.056	0.691
2020.4	3.2	5.3	3.2	4.4	6.5	0.022	0.044	0.193	0.248	0.054	0.702
10-yr mean	**3.20**	**5.78**	**3.51**	**3.82**	**5.84**						
56-yr mean	**3.22**	**5.82**	**3.50**	**5.02**	**7.22**						
					Run 2. Dollar Depreciation						
					Actual values						
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.364
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.391
2009.4	0.1	10.0	0.7	0.1	5.2	0.031	0.018	0.168	0.259	0.091	0.456
					Forecast values						
2010.4	3.9	8.4	1.7	1.1	4.7	0.034	0.023	0.172	0.243	0.072	0.549
2011.4	3.4	7.0	3.9	2.5	4.8	0.036	0.026	0.175	0.239	0.064	0.578
2012.4	3.6	6.2	5.1	3.7	5.3	0.035	0.028	0.178	0.239	0.061	0.591
2013.4	3.6	5.8	5.5	4.5	5.8	0.034	0.030	0.180	0.238	0.058	0.598
2014.4	3.6	5.4	5.5	5.1	6.4	0.033	0.032	0.181	0.238	0.057	0.602
2015.4	3.2	5.3	5.2	5.4	6.9	0.033	0.035	0.183	0.240	0.057	0.608
2016.4	3.0	5.3	4.9	5.5	7.2	0.031	0.037	0.184	0.242	0.058	0.618
2017.4	2.9	5.4	4.6	5.5	7.4	0.028	0.040	0.186	0.244	0.059	0.630
2018.4	3.0	5.4	4.4	5.4	7.5	0.024	0.042	0.187	0.246	0.059	0.642
2019.4	3.2	5.3	4.4	5.5	7.6	0.019	0.044	0.189	0.247	0.059	0.652
2020.4	3.5	5.0	4.5	5.7	7.8	0.013	0.046	0.190	0.248	0.057	0.659
10-yr mean	**3.30**	**5.74**	**4.77**	**4.77**	**6.56**						

10-year real output gain versus run 1: $370 billion (0.23 percent).

Table 2 (continued)

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
Run 3. Sluggish Stock Market											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.364
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.391
2009.4	0.1	10.0	0.7	0.1	5.2	0.031	0.018	0.168	0.259	0.091	0.456
Forecast values											
2010.4	3.9	8.4	1.7	1.1	4.7	0.034	0.023	0.172	0.243	0.072	0.549
2011.4	3.5	7.0	3.1	2.2	4.7	0.033	0.026	0.176	0.238	0.063	0.581
2012.4	3.5	6.2	3.7	3.1	5.0	0.033	0.028	0.178	0.238	0.060	0.600
2013.4	3.4	5.9	3.9	3.6	5.3	0.033	0.030	0.181	0.238	0.057	0.614
2014.4	3.4	5.7	3.8	3.9	5.6	0.034	0.032	0.183	0.238	0.056	0.626
2015.4	3.1	5.7	3.6	4.0	5.8	0.034	0.034	0.184	0.240	0.056	0.639
2016.4	2.9	5.8	3.4	4.0	6.0	0.033	0.037	0.186	0.242	0.056	0.654
2017.4	2.8	5.9	3.2	3.8	6.0	0.030	0.039	0.188	0.244	0.056	0.671
2018.4	2.9	6.0	3.0	3.7	6.0	0.027	0.040	0.189	0.246	0.056	0.687
2019.4	3.0	6.0	3.0	3.7	6.0	0.023	0.042	0.191	0.247	0.056	0.701
2020.4	3.2	6.0	3.0	3.7	6.0	0.019	0.043	0.193	0.247	0.054	0.712
10-yr mean	**3.18**	**6.11**	**3.39**	**3.48**	**5.60**						
10-year real output loss versus run 1: $398 billion (0.25 percent).											

- **g** = real GDP, four quarter percent change, percentage points.
- **u** = unemployment rate, percentage points.
- π = GDP deflator, four quarter percent change, percentage points.
- **r** = three-month Treasury bill rate, percentage points.
- **R** = AAA bond rate, percentage points.
- **ca** = U.S. current account deficit as a percent of GDP.
- **int** = federal government interest payments as a percent of GDP.
- **rec** = federal government total revenue (NIPA) as a percent of GDP.
- **exp** = federal government total expenditure (NIPA) as a percent of GDP (expenditures include interest payments).
- **def** = federal government deficit (NIPA) as a percent of GDP.
- **debt** = federal government debt as a percent of GDP.

is forecasting the next decade to be similar to average behavior in the past. The inflation forecasts (mean 3.51 percent) are higher than the current consensus view (for example, higher than the CBO's forecasts, which are 1.5 percent or less) but equal to the historical average. Baring any large shocks, which are not assumed for the baseline case, the U.S. price equation in the model tends to predict historically average behavior in the long run. The Fed is, however, predicted to run an easier monetary policy than the historical average. The mean of the short term interest rate (**r**) is 3.82 for the 10-year period and 5.02 for the 56-year period.

The debt/GDP ratio (**debt**) was .364 in 2007:4, .391 in 2008:4, and .456 in 2009:4, and it is predicted to rise to .702 in 2020:4. The definition of the federal debt varies somewhat across studies, and for comparison purposes it is best to look at changes rather than levels. The CBO analysis cited above had a change of .270 between 2008 and 2019, which compares to .300 in Table 2. Auerbach and Gale had a change of .354 between 2009 and 2019, which compares to .235 in Table 2. The Obama administration had a change of .242 between 2009 and 2020, which compares to .246 in Table 2. The present numbers are thus in line with those from the CBO and the Obama administration. Auerbach and Gale are more pessimistic. Remember that in this study fairly modest growth rates have been used for federal transfers (see Table 1), and this could be too optimistic. The use of larger growth rates would obviously move the debt/GDP forecasts closer to those of Auerbach and Gale. As noted above, the main conclusions of this paper are not sensitive to the baseline values. Similar conclusions would be reached if the baseline run were more pessimistic about the debt/GDP ratio.

The ratio of the federal deficit to GDP (**def**) was .018 in 2007:4, .047 in 2008:4, and .091 in 2009:4. It is predicted to stabilize at about .055 in 2013. The ratio of federal interest payments to GDP (**int**) rises to .044 by 2020. The U.S. current account deficit as a percent of GDP (**ca**) is fairly stable throughout the period at about .033. Although not shown, there are no large changes in the debt/GDP ratio of S&L governments, which, as noted above, was imposed in the choice of the tax and spending variables of the S&L governments.

The baseline run shows that without bad shocks like bad asset-market reactions, the U.S. economy is predicted to have a roughly historically average performance over the next decade even though the debt/GDP ratio is rising fairly rapidly. It takes (unpredictable) asset-market reactions to change the story, which will now be discussed.

4 Two Alternative Runs

Dollar Depreciation

As noted in Section 1, a concern of many people is that the large deficits will lead to a large depreciation of the U.S. dollar. Since exchange rates are essentially unforecastable, it is not possible to predict something like this ahead of time. What is done here is simply to assume that a depreciation of the dollar will take place and examine its macro consequences. The assumption here is that beginning in 2011 people begin to lose confidence in the dollar, which leads to a depreciation of the dollar and a rise in the dollar price of oil. The depreciation is handled by shocking each exchange rate equation in the MC model beginning in 2011:1. The size of the shock was such that if nothing else changed the currency would appreciate relative to dollar by 25 percent in the long run. For example, if the euro were 0.7 in 2010:4, the shock was such as to make it 0.525 in the long run, other things being equal. The speed in approaching the long run value for a country is determined by the size of the coefficient estimate of the lagged exchange rate in the country's estimated exchange rate equation. Other things do, of course, change in response to the exchange rate shocks, which in turn affects the exchange rate equations, and so the long run appreciation is generally not 25 percent. The currencies of countries with no exchange rate equations were smoothly appreciated over the 10-year period to reach an appreciation of 25 percent in 2020:4. The price of exports in local currency was not changed for any country, including the oil exporting countries, which has the effect of increasing the dollar price of oil since the exchange rates of the oil exporting countries were appreciated. By 2020 the dollar price of oil is roughly 25 percent higher.

The results for this run (run 2) are presented second in Table 2. The 10-year mean of the U.S. inflation rate is now 4.77 percent compared to 3.51 percent in the baseline run. The growth rate is slightly higher and the unemployment rate slightly lower. Over the 10-year period there is a real output gain of 0.23 percent. A depreciation is thus inflationary and expansionary, as expected. The expansion is modest, because, as discussed in Section 2, inflation is, other things being equal, contractionary due to the fall in real wealth and real wages. Also in this case the nominal interest rate rises, which is contractionary. Although not shown, real exports are up and real imports are down substantially. The current account deficit does not fall much until near the end of the period because of the J-curve effect (the rise in the price of imports, other things being equal, increases the current account deficit).

The debt/GDP ratio in 2020:4 is .659 compared to .702 in the baseline run. There has thus been only a modest improvement in the ratio. This "only modest" improvement is in part due to the fact that interest payments as a fraction of GDP are higher because of the higher interest rates set by the Fed in its fight against inflation. Also, much of federal government spending is tied to the rate of inflation in the model, and so spending increases as inflation increases. The overall results thus suggest that a depreciation is not likely to stabilize the debt/GDP ratio. The debt cannot be inflated away in this way.

Sluggish U.S. Stock Prices

Run 3 assumes that a lack of confidence in the United States takes the form of lower U.S. stock prices from those in the baseline run. The constant term in the capital gains (CG) equation was cut in half for this run. No other changes were made. In the baseline run the sum of capital gains over the 10 years is $20.3 trillion (nominal), and in run 3 it is $10.7 trillion, a decrease of $9.6 trillion. The results for run 3 are presented third in Table 2.

Comparing run 3 to the baseline run, the negative wealth effect leads to lower output growth and higher unemployment. Interest rates are lower because the Fed responds to both inflation and unemployment according to the estimated interest rate rule. The real output loss over the 10 years is $398 billion (2005 dollars), or 0.25 percent. This output loss is 4.1 percent of the $9.6 trillion decrease in capital gains, about 4 *real* cents per *nominal* dollar. Nominal GDP is $1.8 trillion lower in run 3 versus the baseline run (not shown), but much of this is because of the lower rate of inflation rather than a decrease in real output. As noted in Section 2, there is a wealth effect on labor supply in the model: a decrease in wealth has a positive effect on labor supply (income effect). The lower wealth in run 3 thus leads, other things being equal, to a larger labor force, which means, other thing being equal, that the unemployment rate is higher.

The debt/GDP ratio is .712 in 2020:4 compared to .702 in the baseline run. The more sluggish economy hurts the ratio and the lower interest rates help, and the net effect is small. The main cost of sluggish stock prices is lost real output; the effect on the debt/GDP ratio is small.

5 Three Policy Experiments

Three policy experiments were performed off of the baseline run. Run 4 imposes a personal income tax increase; run 5 imposes a cut in federal transfer payments to households, and run 6 imposes a national sales tax.[1] Each change is assumed to be imposed in 2011:1 and be sustained. The amount of the revenue increase or the spending decrease is taken to be roughly 3 percent of nominal GDP. For example, nominal GDP in 2011 in the baseline run is about $16 trillion, and 3 percent of this is $480 billion. This is a substantial tax increase or spending cut. These runs are the same as the baseline run except for the tax or spending changes. These changes are not phased in. The changes all go into effect in 2011:1. In practice they would probably be phased in, but for present purposes this does not matter much. What is of interest are the long run responses, and these are not sensitive to whether the changes are phased in or not. The results are presented in Table 3.

[1]There is an aggregate federal personal income tax rate (D1G) and an aggregate federal indirect business tax rate (D3G) in the US model. These rates are based on NIPA data. For run 4 D1G was increased, and for run 6 D3G was increased, each by enough to raise revenue of roughly 3 percent of nominal GDP.

Table 3
Three Policy Changes

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
Run 4. Increase in Federal Personal Income Tax Rate											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.364
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.391
2009.4	0.1	10.0	0.7	0.1	5.2	0.031	0.018	0.168	0.259	0.091	0.456
Forecast values											
2010.4	3.9	8.4	1.7	1.1	4.7	0.034	0.023	0.172	0.243	0.072	0.549
2011.4	0.7	8.0	2.9	1.4	4.4	0.028	0.025	0.204	0.243	0.039	0.572
2012.4	3.5	7.5	3.1	1.9	4.4	0.022	0.026	0.206	0.242	0.036	0.572
2013.4	4.4	6.6	3.6	2.8	4.7	0.020	0.026	0.209	0.237	0.029	0.559
2014.4	4.1	5.7	3.9	3.7	5.1	0.021	0.026	0.211	0.235	0.024	0.541
2015.4	3.3	5.4	3.8	4.1	5.6	0.022	0.027	0.213	0.234	0.021	0.525
2016.4	2.9	5.4	3.6	4.2	5.9	0.023	0.027	0.214	0.235	0.020	0.512
2017.4	2.7	5.6	3.3	4.1	6.0	0.022	0.028	0.215	0.235	0.020	0.501
2018.4	2.8	5.7	3.2	4.0	6.1	0.020	0.028	0.216	0.236	0.020	0.491
2019.4	2.9	5.7	3.2	4.0	6.2	0.015	0.028	0.217	0.236	0.018	0.480
2020.4	3.1	5.6	3.2	4.1	6.3	0.010	0.028	0.219	0.235	0.016	0.466
10-yr mean	**3.05**	**6.21**	**3.38**	**3.33**	**5.40**						
10-year real output loss versus run 1: $2.668 trillion (1.64 percent).											
Run 5. Decrease in Federal Transfer Payments to Households											
Actual values											
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.364
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.391
2009.4	0.1	10.0	0.7	0.1	5.2	0.031	0.018	0.168	0.259	0.091	0.456
Forecast values											
2010.4	3.9	8.4	1.7	1.1	4.7	0.034	0.023	0.172	0.243	0.072	0.549
2011.4	0.6	8.2	2.9	1.2	4.3	0.028	0.025	0.174	0.213	0.039	0.573
2012.4	3.6	7.8	3.0	1.6	4.2	0.021	0.026	0.176	0.211	0.035	0.573
2013.4	4.5	6.9	3.5	2.5	4.5	0.019	0.026	0.179	0.207	0.028	0.558
2014.4	4.2	6.0	3.8	3.4	4.9	0.021	0.026	0.181	0.204	0.023	0.539
2015.4	3.4	5.7	3.8	3.8	5.3	0.023	0.026	0.183	0.203	0.020	0.522
2016.4	2.9	5.7	3.5	3.9	5.6	0.024	0.027	0.184	0.203	0.019	0.508
2017.4	2.7	5.9	3.2	3.7	5.7	0.023	0.027	0.185	0.204	0.018	0.497
2018.4	2.8	6.1	3.1	3.6	5.8	0.020	0.027	0.186	0.204	0.018	0.485
2019.4	2.9	6.2	3.1	3.6	5.8	0.016	0.027	0.187	0.204	0.016	0.472
2020.4	3.1	6.1	3.2	3.7	5.9	0.010	0.027	0.189	0.202	0.014	0.457
10-yr mean	**3.07**	**6.53**	**3.30**	**3.02**	**5.17**						
10-year real output loss versus run 1: $2.526 trillion (1.56 percent).											

Table 3 (continued)

qtr	g	u	π	r	R	ca	int	rec	exp	def	debt
					Run 6. National Sales Tax						
					Actual values						
2007.4	2.5	4.8	2.7	3.4	5.5	0.046	0.020	0.183	0.202	0.018	0.364
2008.4	-1.9	6.9	2.0	0.3	5.8	0.044	0.016	0.167	0.214	0.047	0.391
2009.4	0.1	10.0	0.7	0.1	5.2	0.031	0.018	0.168	0.259	0.091	0.456
					Forecast values						
2010.4	3.9	8.4	1.7	1.1	4.7	0.034	0.023	0.172	0.243	0.072	0.549
2011.4	-1.5	9.0	6.1	0.5	4.1	0.022	0.025	0.196	0.246	0.050	0.576
2012.4	3.2	9.2	2.4	0.5	3.7	0.011	0.026	0.197	0.245	0.048	0.593
2013.4	5.3	7.8	3.2	1.7	3.8	0.007	0.026	0.200	0.238	0.039	0.586
2014.4	4.8	6.4	3.9	3.0	4.4	0.009	0.026	0.202	0.234	0.032	0.571
2015.4	3.7	5.8	4.0	3.6	4.9	0.012	0.026	0.204	0.233	0.029	0.557
2016.4	3.0	5.7	3.7	3.8	5.3	0.015	0.027	0.205	0.233	0.028	0.548
2017.4	2.8	5.9	3.4	3.8	5.5	0.016	0.028	0.206	0.234	0.028	0.543
2018.4	2.7	6.1	3.2	3.7	5.7	0.015	0.029	0.207	0.235	0.028	0.538
2019.4	2.9	6.2	3.2	3.6	5.8	0.011	0.029	0.208	0.235	0.027	0.533
2020.4	3.1	6.1	3.3	3.7	5.8	0.005	0.030	0.209	0.235	0.026	0.526
10-yr mean	**3.01**	**6.87**	**3.66**	**2.69**	**4.85**						
10-year real output loss versus run 1: $4.180 trillion (2.58 percent).											

• See notes to Table 2.

Consider runs 4 and 5 first. The effects in the model of changing personal income tax rates and transfer payments are similar; they both affect the disposable income of the household sector. One difference is that a tax rate increase has a negative effect on labor force participation, and so the labor force is smaller, other things being equal, in the tax rate case than in the transfer case. This results in a smaller unemployment rate, other things being equal, in the tax rate case. In run 4 the unemployment rate is 5.6 percent at the end of the period, which compares to 6.1 percent in run 5. On the other hand, the sum of the real output losses are similar: $2.688 trillion (1.64 percent) in run 4 and $2.526 trillion (1.56 percent) in run 5. The tax increases and spending decreases are thus contractionary, as expected. The

Fed is estimated to lower the interest rate in response to the contraction (10-year mean of 3.33 in run 4 and 3.02 in run 5 compared to 3.82 in the baseline run). This offsets some of the contraction, but by no means all. Runs 4 and 5 do stabilize the debt/GDP ratio. By 2020, the deficit as a percent of GDP falls to 1.6 percent in run 4 and 1.4 percent in run 5. The debt/GDP ratio in 2020:4 is .466 in run 4 and .457 in run 5.

Runs 4 and 5 use the estimated interest rate rule of the Fed, and, as just discussed, the Fed is estimated to lower the interest rate in response to the tax increases and spending decreases. The output loss would obviously be less if the Fed lowered the interest rate more. When, for example, the interest rate rule is dropped and the short term interest rate is taken to be 1.0 percent from 2011:1 on for run 4, the output loss falls to 0.97 percent from 1.64 percent. Inflation is higher, with the 10-year mean rate being 3.66 percent instead of 3.38 percent. This is, of course, an extreme case since it seems unlikely that the Fed would keep the interest rate at 1.0 percent in face of 3.66 percent inflation. This behavior is far from the Fed's estimated behavior in the sample period (1954:1–2009:4). This experiment does show, however, that even in this extreme case, there is still a nontrivial output loss. As noted in Section 2, monetary policy cannot come close to eliminating business cycles according to the model.

In run 6 a federal sales tax increase was imposed on total nominal consumption (services, nondurables, and durables). The size of the tax increase was chosen to raise revenue of roughly 3 percent of GDP. This is a large tax increase and it is on all consumption, which may be difficult to implement. This experiment should, however, give one a general idea of the effects of a sales tax increase. In the model sales taxes are passed on to consumers, and so there is a large one-time price increase when the sales tax is imposed. This results in a fall in real wealth and in the real wage, which are contractionary. The results in Table 3 show that the contraction is larger for run 6 than for runs 4 and 5. The sum of the real output loss over the 10 years is 2.58 percent, about one percentage point higher than for runs 4 and 5. There is also more inflation using the GDP deflator because sales taxes are in the GDP deflator. Due primarily to the more sluggish economy, the debt/GDP ratio does not fall as much. It falls to .526, compared to .466 and .457 for runs 4 and 5, respectively. Although this experiment is pushing the model outside normal behavior and thus has more uncertainty attached to it, the results suggest that a national sales tax has more output costs than do personal tax increases and spending cuts.

6 Conclusion

This paper provides estimates of possible macroeconomic consequences of large future federal government deficits. The results are conditional on essentially unforecastable events: flight from the dollar, stock market stagnation, personal tax increases, transfer payment decreases, and a national sales tax. In other words, the results are conditional on asset market behavior and government policy behavior, both of which are not forecastable. The main conclusions are:

1. Assuming no major changes in federal government tax and spending policies, the federal debt as a percent of GDP rises to about 70 percent by 2020. This rise is similar to that of the CBO (2009b) and the February 1, 2010, release of the Obama administration's budget. The rise is somewhat smaller than

that of Auerbach and Gale (2009). In the present case all the macroeconomic endogeneity has been accounted for.

2. A depreciation of the dollar leads to inflation, as expected, but this is of only modest help regarding the debt problem. It does not appear that the United States can inflate away its debt problem.

3. Sluggish stock prices make the picture worse. Output is lower and the debt/GDP ratio is higher.

4. Personal income tax increases and transfer payment decreases have similar effects on the economy. A tax increase or spending decrease of 3 percent of nominal GDP is enough to stabilize the debt/GDP ratio. The real output loss over the decade is about 1.6 percent.

5. A national sales tax is more contractionary in the model than are personal tax increases and transfer decreases, due in large part to decreases in real wealth and real wages. There is, however, more uncertainty here regarding the ability of the model to deal with the sales-tax case.

6. In the estimated interest rate rule of the Fed both inflation and unemployment matter, and so the Fed's response to shocks depends on how these two variables are affected. The estimated effects of interest rate changes on the economy in the model are not large enough to have the Fed come close to offsetting the output loss from the tax increases or spending decreases.

As noted in Section 2, the experiments in this paper do not take account of possibly higher interest rates on federal government securities because of added risk. Because of this, the results in this paper may not be pessimistic enough. It may also be that the baseline run has underestimated the growth in federal spending and thus the deficit and debt. If this is the case, then all the runs are off, but the *differences* between the runs are much less affected. In other words, the conclusions above are not much affected by different baseline runs.

References

[1] Auerbach, Alan J., and William G. Gale, 2009, "The Economic Crisis and the Fiscal Crisis: 2009 and Beyond: An Update," September.

[2] Congressional Budget Office, 2009a, Letter to Charles E. Grassley, March 2.

[3] Congressional Budget Office, 2009b, "The Budget and Economic Outlook: An Update," August.

[4] Fair, Ray C., 2004, *Estimating How the Macroeconomy Works*. Cambridge, MA: Harvard University Press.

[5] Fair, Ray C., 2005, "Estimates of the Effectiveness of Monetary Policy," *Journal of Money, Credit and Banking*, 645–660.

[6] Fair, Ray C., 2008, "Testing Price Equations," *European Economic Review*, 1424–1437.

[7] Fair, Ray C., 2009a, "Has Macro Progressed?" September.

[8] Fair, Ray C., 2009b, "Analyzing Macroeconomic Forecastability," September.

[9] Galí, Jordi, and Mark Gertler, 2007, "Macroeconomic Modeling for Monetary Policy Evaluation," *Journal of Economic Perspectives*, 21, 25–45.